

Amendments to the Claims

The following Listing of Claims replaces all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (currently amended): A method of processing an input image, comprising:
sub-sampling the input image to generate a thumbnail image comprising a reduced-size version of the input image in its entirety; and
detecting redeye pixel areas in the thumbnail image.

Claim 2 (original): The method of claim 1, wherein detecting redeye pixel areas comprises computing measures of pixel redness in the thumbnail image, and identifying a preliminary set of candidate redeye pixel areas based on the computed pixel redness measures.

Claim 3 (original): The method of claim 2, wherein pixel redness measures are computed based on a ratio of a measure of a red component of pixel energy to a measure of total pixel energy.

Claim 4 (currently amended): The method of claim 2, wherein identifying the preliminary set of candidate redeye pixel areas comprises applying a two-dimensional redness filter to the computed pixel redness measures, wherein the redness filter is operable to compute for each region of the thumbnail image a respective redness score based on a comparison of an average of ones of the pixel redness measures in a central kernel pixel area of the thumbnail image and an average of the pixel redness measures in a pixel area of the thumbnail image surrounding the kernel pixel area.

Claim 5 (original): The method of claim 4, further comprising applying a prescribed threshold to the computed redness scores to identify candidate redeye pixels.

Claim 6 (original): The method of claim 5, wherein detecting redeye pixel areas further comprises segmenting redeye pixels by scanning a redness map of the redness measures in stripes of one or more pixel lines and tracking objects containing candidate redeye pixels connected across stripes.

Claim 7 (original): The method of claim 4, wherein detecting redeye pixel areas further comprises filtering from the preliminary set each candidate redeye pixel area having a computed redness contrast relative to at least one respective neighboring pixel area less than a prescribed redness contrast threshold.

Claim 8 (original): The method of claim 7, wherein each candidate redeye pixel area having a computed redness contrast relative to each of a set of corresponding surrounding pixel areas less than the prescribed redness contrast threshold is filtered from the preliminary set.

Claim 9 (currently amended): A method of processing an input image, comprising:
sub-sampling the input image to generate a thumbnail image; and
detecting redeye pixel areas in the thumbnail image, wherein detecting redeye pixel
areas comprises computing measures of pixel redness in the thumbnail image, and identifying
a preliminary set of candidate redeye pixel areas based on the computed pixel redness
measures, wherein identifying the preliminary set of candidate redeye pixel areas comprises enlarging a given candidate redeye pixel area having a dimension below a threshold size to generate an enlarged pixel area.

Claim 10 (original): The method of claim 9, wherein identifying the preliminary set of candidate redeye pixel areas comprises comparing the enlarged pixel area to multiple pixel areas surrounding the enlarged pixel area, and selecting a pixel area to replace the given candidate redeye pixel area from among the enlarged pixel area and the surrounding pixel areas based on measures of redness computed for each of the enlarged pixel area and the surrounding pixel areas.

Claim 11 (original): The method of claim 2, wherein detecting redeye pixel areas further comprises filtering from the preliminary set each candidate redeye pixel area located in an area of the digital image having a computed grayscale contrast relative to at least one respective neighboring pixel area less than a prescribed grayscale contrast threshold.

Claim 12 (original): The method of claim 11, further comprising:
computing measures of pixel grayscale in the digital image;
computing, for a given candidate redeye pixel area, a candidate iris area centered at the given candidate redeye pixel area and having a size maximizing grayscale contrast between the candidate iris area and areas surrounding the candidate iris area;
computing a measure of grayscale contrast between the candidate iris area and at least a portion of the areas surrounding the candidate iris area;
and applying a threshold to the computed grayscale contrast measure to filter candidate redeye pixel areas from the preliminary set.

Claim 13 (original): The method of claim 2, further comprising:
identifying a pixel boundary of a pixel region surrounding a given candidate redeye pixel area;
classifying pixels within the pixel boundary as red pixels and non-red pixels by applying a threshold to the computed pixel redness measures; and
filtering the given candidate redeye pixel area from the preliminary set when a set of contiguous red pixels extends from the given candidate redeye pixel area to the pixel boundary.

Claim 14 (original): The method of claim 13, further comprising identifying the set of contiguous pixels by scanning a redness map of the redness measures in stripes of one or more pixel lines and tracking objects containing red pixels connected across stripes.

Claim 15 (original): The method of claim 2, further comprising filtering candidate redeye pixel areas from the preliminary set based on proportions of detected skin tone pixels in regions respectively surrounding the candidate redeye pixels areas.

Claim 16 (original): The method of claim 2, further comprising pairing candidate redeye pixel areas in the preliminary set, and filtering unpaired candidate redeye pixels areas from the preliminary set.

Claim 17 (original): The method of claim 16, wherein pairing candidate redeye pixel areas comprises comparing a candidate texture pattern computed for a candidate pair of candidate redeye pixel areas in the preliminary set with a reference texture pattern.

Claim 18 (currently amended): A method of processing an input image, comprising:
sub-sampling the input image to generate a thumbnail image;
detecting redeye pixel areas in the thumbnail image, wherein detecting redeye pixel
areas comprises computing measures of pixel redness in the thumbnail image, and identifying
a preliminary set of candidate redeye pixel areas based on the computed pixel redness
measures;

pairing candidate redeye pixel areas in the preliminary set, wherein pairing candidate
redeye pixel areas comprises comparing a candidate texture pattern computed for a candidate
pair of candidate redeye pixel areas in the preliminary set with a reference texture pattern
~~The method of claim 17,~~ wherein comparing the candidate texture pattern with the reference
texture pattern comprises generating a feature vector representative of the candidate texture
pattern and comparing the generated feature vector with a statistical model of the reference
texture pattern; and

filtering unpaired candidate redeye pixels areas from the preliminary set.

Claim 19 (original): The method of claim 18, wherein generating the feature vector
representative of the candidate texture pattern comprises mapping a candidate redeye pair
region encompassing the candidate redeye pair to a standardized candidate redeye pair
template.

Claim 20 (original): The method of claim 19, wherein mapping the candidate redeye
pair region comprises cropping a pixel region from a grayscale map of the thumbnail image,
rotating the cropped pixel region, and scaling the rotated pixel region.

Claim 21 (original): The method of claim 20, wherein mapping the candidate redeye pair region comprises normalizing and equalizing the scaled pixel region.

Claim 22 (original): The method of claim 19, wherein generating the feature vector representative of the candidate texture pattern comprises converting the mapped candidate redeye pair region to the feature vector.

Claim 23 (original): The method of claim 1, further comprising detecting redeye pixel areas in the input image, and generating a set of detected redeye pixel areas by merging redeye pixel areas detected in the input image with redeye pixel areas detected in the thumbnail image.

Claim 24 (original): The method of claim 1, further comprising correcting redeye in the input image based on redeye pixel areas detected in the thumbnail image.

Claim 25 (original): The method of claim 24, wherein correcting redeye comprises mapping the detected redeye pixel areas to the input image.

Claim 26 (original): The method of claim 25, wherein correcting redeye comprises enlarging redeye pixel areas mapped to the input image.

Claim 27 (original): The method of claim 26, wherein the mapped redeye pixel areas are enlarged by amounts decreasing inversely with respect to original sizes of the mapped redeye pixel areas.

Claim 28 (original): The method of claim 26, further comprising cropping corners from each of the enlarged redeye pixel areas.

Claim 29 (original): The method of claim 25, further comprising classifying pixels as redeye pixels for correction before mapping detected redeye pixel areas to the input image.

Claim 30 (currently amended): A method of processing an input image, comprising:

sub-sampling the input image to generate a thumbnail image;
detecting redeye pixel areas in the thumbnail image; and
correcting redeye in the input image based on redeye pixel areas detected in the
thumbnail image
The method of claim 24, wherein correcting redeye comprises identifying discrete redeye pixel areas separated from eyelid regions.

Claim 31 (original): The method of claim 30, wherein identifying discrete redeye pixel areas comprises comparing at least one redeye pixel area size dimension to a threshold.

Claim 32 (original): The method of claim 31, wherein a discrete redeye pixel area is identified based at least in part on a prescribed fraction of a respective grayscale iris area centered at a corresponding pixel area and having a size maximizing grayscale contrast between the grayscale iris area and areas surrounding the grayscale iris area.

Claim 33 (original): The method of claim 30, wherein correcting redeye comprises classifying pixels in each non-discrete redeye pixel area based on skin tone coloration.

Claim 34 (currently amended): The method of claim 2426, wherein the correcting redeye comprises classifying pixels in each of the mapped redeye pixel areas based on a redness threshold.

Claim 35 (currently amended): The method of claim 2426, wherein the pixels in each of the mapped redeye pixel areas are classified on a pixel-by-pixel basis.

Claim 36 (currently amended): The method of claim 2426, wherein each pixel in the mapped redeye pixel areas is classified with reference to an adjacent, previously-classified pixel.

Claim 37 (currently amended): A method of processing an input image, comprising:
sub-sampling the input image to generate a thumbnail image;
detecting redeye pixel areas in the thumbnail image; and

correcting redeye in the input image based on redeye pixel areas detected in the thumbnail image ~~The method of claim 24, wherein correcting redeye comprises classifying pixels between concentric inner and outer bounding regions based on a grayscale threshold.~~

Claim 38 (original): The method of claim 37, further comprising correcting original color values of pixels in a redeye pixel correction region encompassing pixels classified as redeye pixels.

Claim 39 (original): The method of claim 38, wherein original color values of pixels in the redeye pixel correction region are corrected by desaturating original color values.

Claim 40 (original): The method of claim 39, wherein original color values are desaturated by respective amounts varying with pixel location in the final pixel mask.

Claim 41 (original): The method of claim 39, wherein original color values of pixels in the redeye pixel correction region are corrected by darkening the original color values.

Claim 42 (original): The method of claim 38, further comprising correcting original color values of pixels in a smoothing region surrounding the redeye pixel correction region.

Claim 43 (original): The method of claim 42, wherein original color values of pixels in the smoothing region are corrected by an amount decreasing with distance from the given redeye pixel correction region.

Claim 44 (original): The method of claim 43, wherein original color values of pixels in the redeye pixel correction region are corrected without reference to position within the redeye pixel correction region.

Claim 45 (original): The method of claim 37, further comprising computing a size of the inner bounding region between a given redeye pixel area size and a corresponding grayscale iris area size, and computing a size of the outer bounding region larger than the computed size of the inner bounding region by a predetermined relative amount.

Claim 46 (currently amended): The method of claim 2426, wherein original color values of pixels in the mapped redeye pixel areas are corrected based on integer arithmetic computations.

Claim 47 (original): The method of claim 1, further comprising correcting redeye in the thumbnail image based on redeye pixel areas detected in the thumbnail image.

Claim 48 (original): The method of claim 47, further comprising displaying the thumbnail image with corrected redeye, and correcting redeye in the input image based on redeye pixel areas detected in the thumbnail image in respond to a user command.

Claim 49 (original): A method of processing an input image having lines of pixels with original color values, comprising:

detecting one or more redeye pixel areas corresponding to respective areas in the input image;

classifying each pixel in the input image corresponding to the detected redeye pixel areas as a redeye pixel or a non-redeye pixel on a line-by-line basis without reference to pixels in adjacent lines; and

correcting the original color values of pixels in the input image classified as redeye pixels.

Claim 50 (original): The method of claim 49, wherein a pixel in a given line is classified with reference to an adjacent, previously-classified pixel in the given line.

Claim 51 (original): The method of claim 49, wherein correcting redeye comprises identifying discrete redeye pixel areas separated from eyelid regions.

Claim 52 (original): The method of claim 51, wherein identifying discrete redeye pixel areas comprises comparing at least one redeye pixel area size dimension to a threshold.

Claim 53 (original): The method of claim 52, wherein a discrete redeye pixel area is identified based at least in part on a prescribed fraction of a respective grayscale iris area centered at a corresponding pixel area and having a size maximizing grayscale contrast between the grayscale iris area and areas surrounding the grayscale iris area.

Claim 54 (original): The method of claim 51, wherein correcting redeye comprises classifying pixels in each non-discrete redeye pixel area based on skin tone coloration.

Claim 55 (original): The method of claim 49, wherein correcting redeye comprises classifying pixels in each redeye pixel area based on a redness threshold.

Claim 56 (original): The method of claim 49, further comprising correcting original color values of pixels classified as redeye pixels by desaturating original color values.

Claim 57 (original): The method of claim 49, further comprising correcting original color values of pixels classified as redeye pixels by darkening the original color values.

Claim 58 (currently amended): A system for processing an input image, comprising a redeye detection module operable to:

sub-sample the input image to generate a thumbnail image comprising reduced-size versions of all regions of the input image; and
detect redeye pixel areas in the thumbnail image.

Claim 59 (original): The system of claim 58, wherein the redeye detection module computes measures of pixel redness in the thumbnail image and identifies a preliminary set of candidate redeye pixel areas based on the computed pixel redness measures.

Claim 60 (original): The system of claim 59, wherein the redeye detection module applies a two-dimensional redness filter to the computed pixel redness measures, wherein the redness filter is operable to compute a redness score based on a central kernel pixel area and a pixel area surrounding the kernel pixel area.

Claim 61 (currently amended): A system for processing an input image, comprising a redeye detection module operable to:

sub-sample the input image to generate a thumbnail image; and

detect redeye pixel areas in the thumbnail image

wherein the redeye detection module computes measures of pixel redness in the thumbnail image, identifies a preliminary set of candidate redeye pixel areas based on the computed pixel redness measures~~The system of claim 59, wherein the redeye detection module~~and enlarges a given candidate redeye pixel area having a dimension below a threshold size to generate an enlarged pixel area.

Claim 62 (currently amended): A system for processing an input image, comprising a redeye detection module operable to:

sub-sample the input image to generate a thumbnail image; and

detect redeye pixel areas in the thumbnail image

wherein the redeye detection module computes measures of pixel redness in the thumbnail image, identifies a preliminary set of candidate redeye pixel areas based on the computed pixel redness measures~~The system of claim 59, wherein the redeye detection module~~and filters from the preliminary set each candidate redeye pixel area located in an area of the digital image having a computed grayscale contrast relative to at least one respective neighboring pixel area less than a prescribed grayscale contrast threshold.

Claim 63 (currently amended): A system for processing an input image, comprising a redeye detection module operable to:

sub-sample the input image to generate a thumbnail image;

detect redeye pixel areas in the thumbnail image;

wherein the redeye detection module computes measures of pixel redness in the thumbnail image, identifies a preliminary set of candidate redeye pixel areas based on the computed pixel redness measures, and~~The system of claim 59, wherein the redeye detection module~~ is further operable to:

identify a pixel boundary of a pixel region surrounding a given candidate redeye pixel area;

classify pixels within the pixel boundary as red pixels and non-red pixels by applying a threshold to the computed pixel redness measures; and

filter the given candidate redeye pixel area from the preliminary set when a set of contiguous red pixels extends from the given candidate redeye pixel area to the pixel boundary.

Claim 64 (original): The system of claim 59, wherein the redeye detection module filters candidate redeye pixel areas from the preliminary set based on proportions of detected skin tone pixels in regions respectively surrounding the candidate redeye pixels areas.

Claim 65 (original): The system of claim 59, wherein the redeye detection module pairs candidate redeye pixel areas in the preliminary set and filters unpaired candidate redeye pixels areas from the preliminary set.

Claim 66 (original): The system of claim 58, wherein the redeye detection module , detects redeye pixel areas in the input image and generates a set of detected redeye pixel areas by merging redeye pixel areas detected in the input image with redeye pixel areas detected in the thumbnail image.

Claim 67 (original): The system of claim 58, further comprising a redeye correction module operable to correct redeye in the input image based on redeye pixel areas detected in the thumbnail image.

Claim 68 (original): A system for processing an input image having lines of pixels with original color values, comprising:

a redeye detection module operable to detect one or more redeye pixel areas corresponding to respective areas in the input image; and

a redeye correction module operable to classify each pixel in the input image corresponding to the detected redeye pixel areas as a redeye pixel or a non-redeye pixel on a line-by-line basis without reference to pixels in adjacent lines, and to correct the original color values of pixels in the input image classified as redeye pixels.